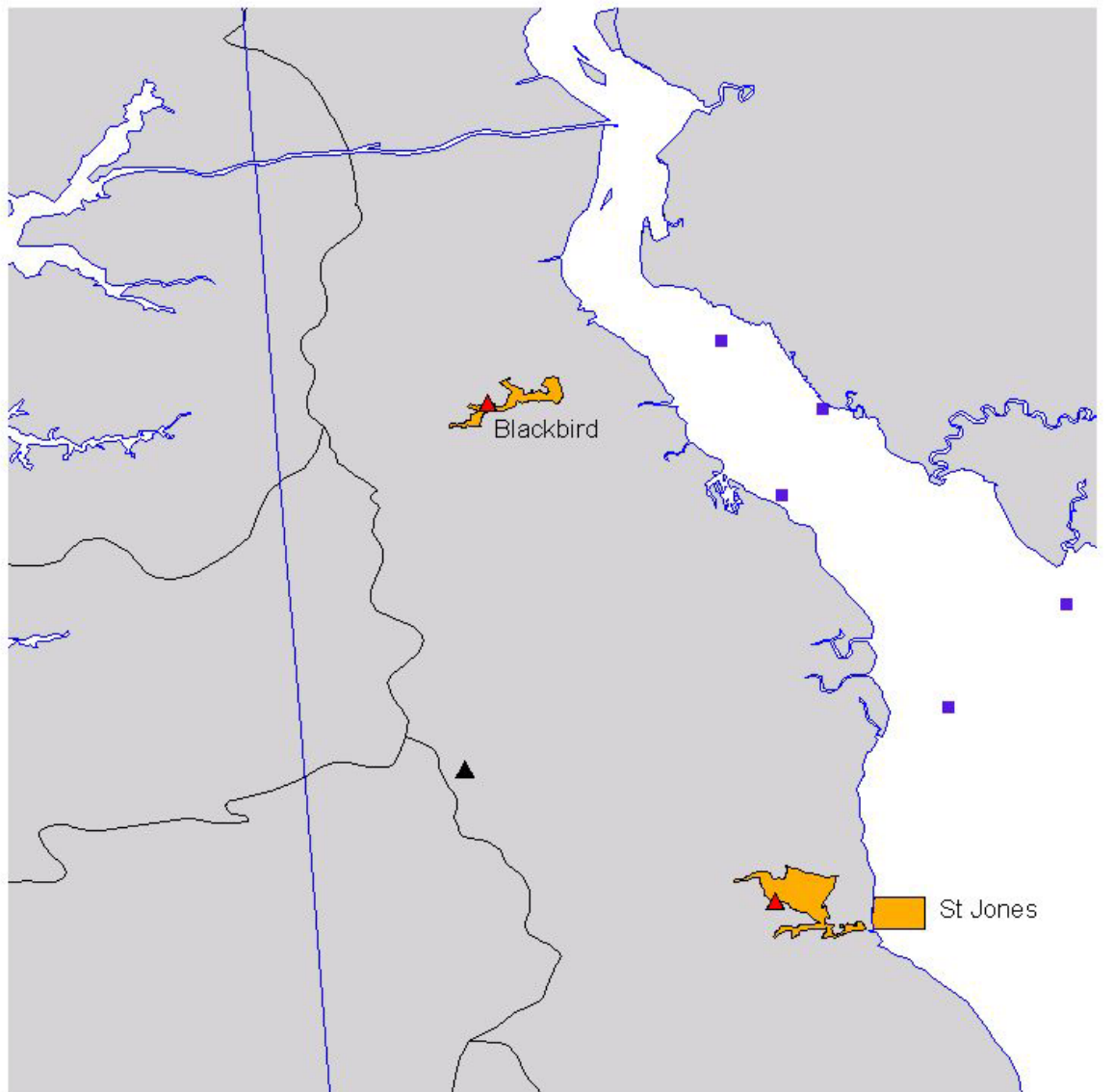


# Delaware



## YSI Sites

- ▲ Within NERR
- ▲ Not Within NERR

- NS&T Mussel Watch
- NS&T Benthic Surveillance

## NERR Management Zone

- Core

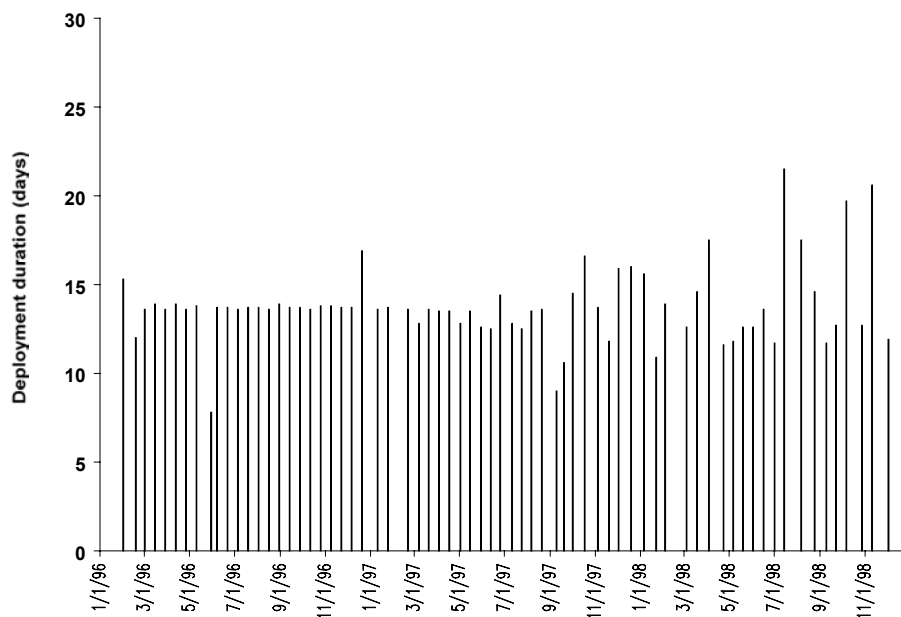
## Delaware Bay, Blackbird Landing (DELBL)

*Characterization (Latitude = 39 23'20"N; Longitude = 75 38'10"W)*

The Blackbird Landing site is located in the upper Blackbird Creek at Blackbird Landing Road. The creek is 25.8 km long (mainstream linear dimension), has an average depth of 3 m MHW, and an average width of about 90 m. At the sampling site, the depth is 1.8 m MHW and the width is about 110 m. Creek bottom habitats are predominantly silt and clay, with no bottom vegetation. The dominant marsh vegetation near the sampling site is *Spartina alterniflora*. The dominant upland vegetation is tidal swamp and upland forest. Upland land use near the sampling site includes forests and agriculture. Activities that potentially impact the site include sporadic refuse dumping. Water quality at this site is influenced by freshwater runoff from un-impacted forested areas intermixed with agricultural land uses and a small amount of low-density development.

### *Descriptive Statistics*

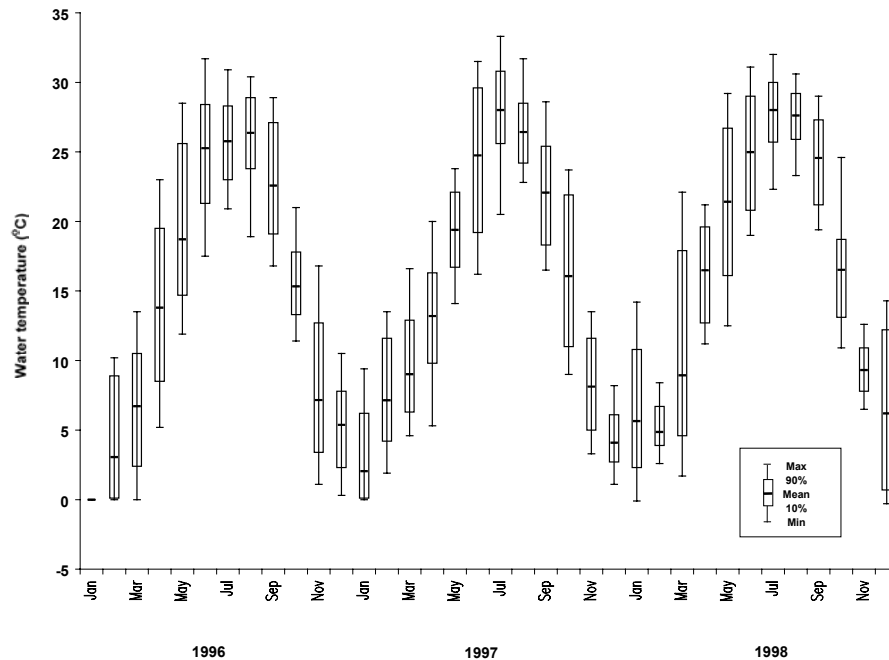
Sixty-nine deployments were made at this site between Feb 1996 and Dec 1998, with equal coverage in all seasons (Figure 103). Mean deployment duration was 13.8 days. Only two deployments (May 1996, Sep 1997) were less than 10 days.



**Figure 103.** Delaware Bay, Blackbird Landing deployments (1996-1998).

Eighty-six percent of annual depth data were included in analyses (84% in 1996, 87% in 1997, 1998). Sensors were deployed at a mean depth of 1.5 m below the water surface and 0.3 m above the bottom sediment. Strong fluctuation (1.5-2 m) in water depth was evident for daily and bi-weekly intervals from scatter plots, with consistent amplitude throughout the data set. Harmonic regression analysis attributed 68% of depth variance to 12.42 hour cycles, 22% of depth variance to interaction between 12.42 hour and 24 hour cycles, and 10% of depth variance to 24 hour cycles.

Eighty-five percent of annual water temperature data were included in analyses (84% in 1996, 87% in 1997, and 84% in 1998). Water temperature followed a seasonal cycle, with mean water temperature 2-5°C in winter and 25-28°C in summer (Figure 104). Minimum and maximum temperatures between 1996-1998 were -0.3°C (Dec 1998) and 33.3°C (Jul 1997), respectively. Scatter plots suggest strong fluctuation (1-4°C) in water temperature over daily cycles and even stronger fluctuation ( $\geq 5^\circ\text{C}$ ) at bi-weekly intervals. Harmonic regression analysis attributed 47% of temperature variance to 24 hour cycles, 45% of temperature variance to interaction between 12.42 hour and 24 hour cycles, and 8% of temperature variance to 12.42 hour cycles.

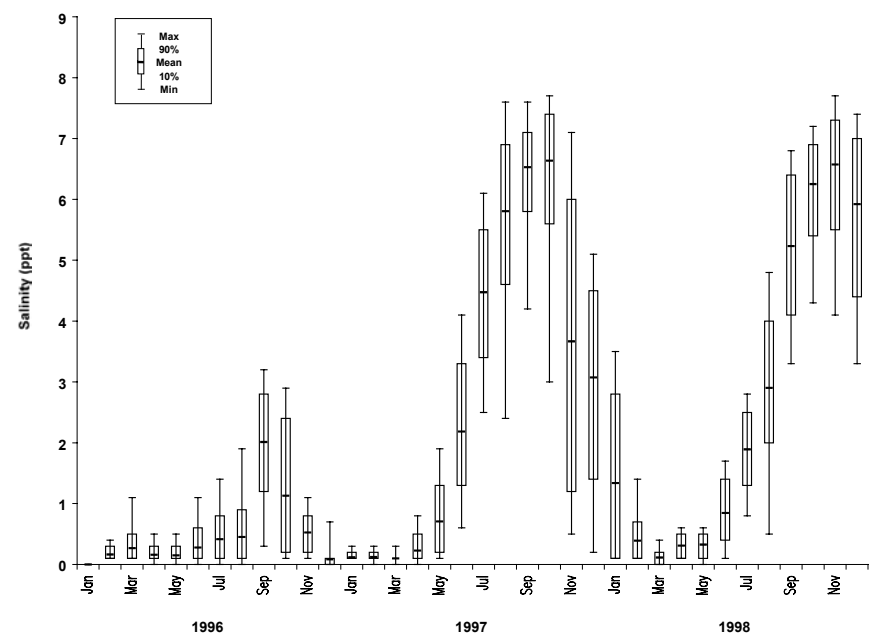


**Figure 104.** Water temperature statistics for Blackbird Landing, 1996-1998.

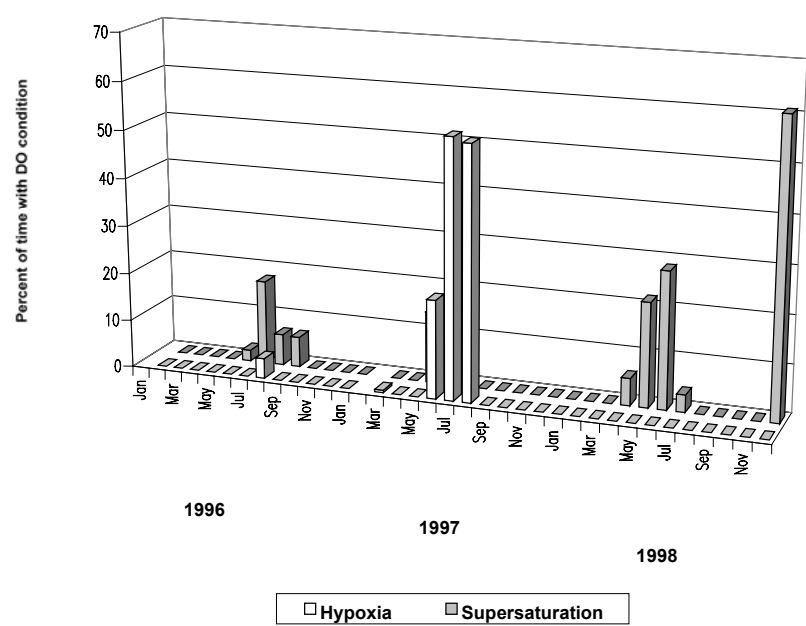
Eighty-four percent of annual salinity data were included in analyses (84% in 1996, 1997, and 1998). Salinity followed an expected seasonal cycle in 1997 and 1998 and to a lesser extent in 1996 (Figure 105). Mean salinity in 1997-1998 was 6-7 ppt in summer and  $<1$  ppt in winter. Mean salinity in 1996 was 1-2 ppt in summer and  $<1$  ppt in winter. Zero salinity was regularly observed in winter. Maximum observed salinity never exceeded 8 ppt. Harmonic regression analysis attributed 69% of salinity variance to 12.42 hour cycles, 21% of salinity variance to interaction between 12.42 hour and 24 hour cycles, and 10% of salinity variance to 24 hour cycles.

Eighty-four percent of annual dissolved oxygen (% saturation) data were included in analyses (84% in 1996 and 1998, 83% in 1997). Mean percent saturation remained between 60-100% for most of the year. Mean dissolved oxygen was only less than 50% saturation on two occasions (Jul-Aug 1997). Mean dissolved oxygen only exceeded 100% saturation on two occasions (Nov-Dec 1998). Minimum and maximum DO recorded between 1996-1998 was 0% saturation (Jun-Sep 1997) and 195.9% saturation (Aug 1996), respectively. Hypoxia was restricted to Jun-Sep and, when present, hypoxia persisted for 26.3% of the first 48 hours post-deployment (Figure 106). Supersaturation was observed on several occasions in spring/summer (and Dec 1998) and, when present, supersaturation persisted for 16.8% of the first 48 hours post-deployment on average. Scatter plots document strong

fluctuations (60-100%) in percent saturation of DO in spring and summer and minor fluctuations (20-40%) in percent saturation in fall and winter. Harmonic regression analysis attributed 49% of DO variance to interaction between 12.42 hour and 24 hour cycles, 40% of DO variance to 12.42 hour cycles, and 11% of DO variance to 24 hour cycles.



**Figure 105.** Salinity statistics for Blackbird Landing, 1996-1998.



**Figure 106.** Dissolved oxygen extremes at Blackbird Landing, 1996-1998.

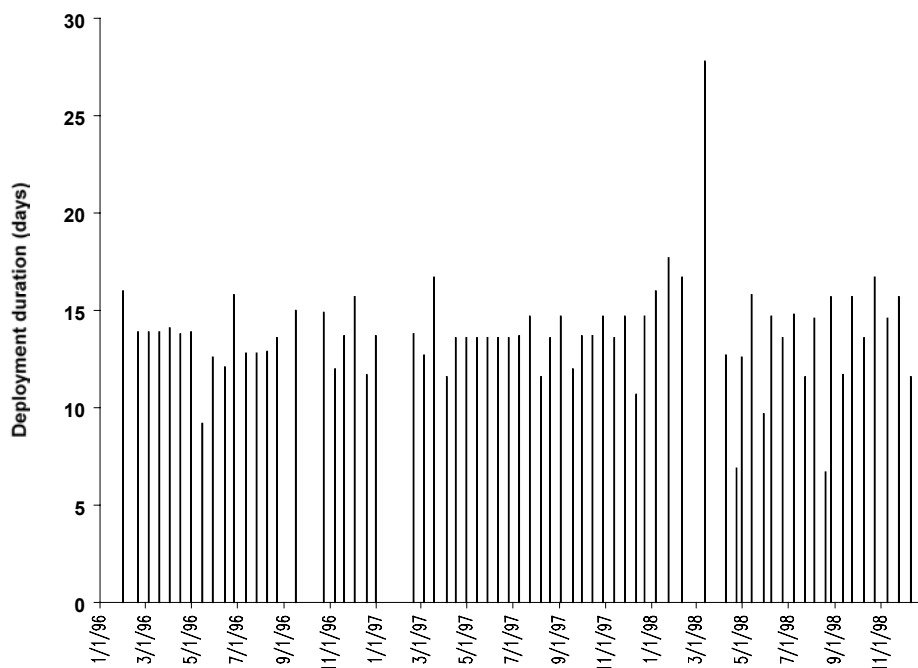
## Delaware Bay, Scotton Landing (DELSL)

*Characterization (Latitude = 39°05'06" N; Longitude = 75°27'38" W)*

The Scotton Landing site is located in the lower St. Jones River at the Scotton Landing Public Fishing Pier, just upstream of Delaware Route 113. The river is 22.3 km long (mainstream linear dimension), has an average depth of 4 m MHW, and an average width of 50 m. At the sampling site, the depth is 3.2 m MHW and the width is 40 m. Creek bottom habitats are predominantly clay and silt, with no bottom vegetation. The dominant marsh vegetation near the sampling site is *Spartina alterniflora* and the dominant upland vegetation includes riparian forest and agricultural crops. Upland land use near the sampling site is primarily agriculture and residential uses. Activities that potentially impact the site include a public boat ramp and freshwater runoff from the relatively urbanized area upstream.

### *Descriptive Statistics*

Sixty-nine deployments were made at this site between Jan 1996 and Dec 1998, with equal coverage in all seasons (Figure 107). Mean deployment duration was 13.8 days. Only four deployments (May 1996, Apr-May 1998, Aug 1998) were less than 10 days.

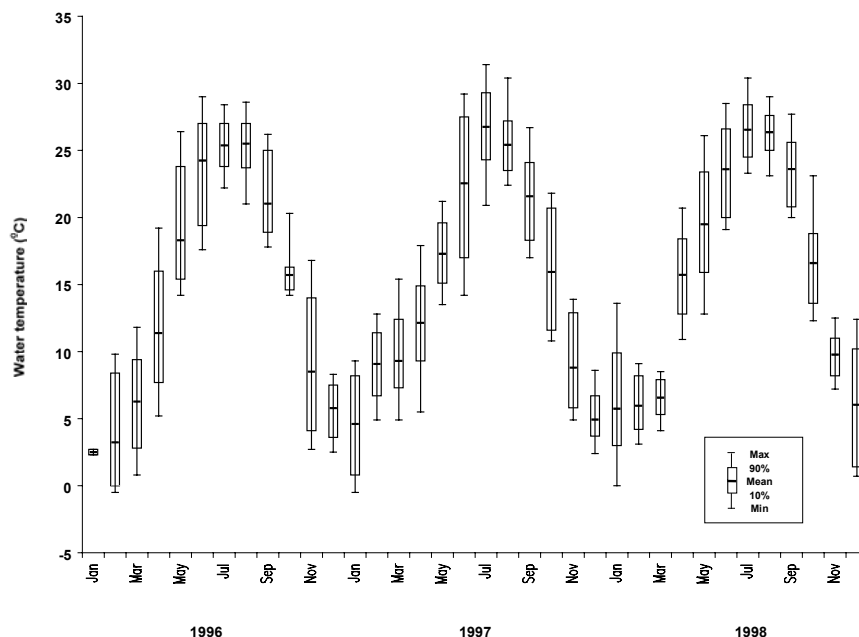


**Figure 107.** Delaware Bay, Scotton Landing deployments (1996-1998).

Eighty-four percent of annual depth data were included in analyses (75% in 1996, 88% in 1997, 1998). Sensors were deployed at a mean depth of 1.5 m below the water surface and 0.3 m above the bottom sediment. Strong fluctuation (1-1.5 m) in water depth was evident from scatter plots for both daily and bi-weekly intervals, and the amplitude of these fluctuations appeared to remain constant throughout all seasons. Harmonic regression analysis attributed 71% of depth variance to 12.42 hour cycles, 21% of depth variance to interaction between 12.42 hour and 24 hour cycles, and 8% of depth variance to 24 hour cycles.

Eighty-four percent of annual water temperature data were included in analyses (75% in 1996, 88% in

1997, 1998). Water temperature data followed a seasonal cycle, with mean water temperature 4-6°C in winter (1997-1998) and 24-26°C in summer (Figure 108). Mean water temperature in winter 1996 was slightly cooler (3-5°C) than winter 1997-1998 (5-8°C). Minimum and maximum water temperatures between 1996-1998 were -0.5°C (Feb 1996, Jan 1997) and 31.4°C (Jul 1997), respectively. Scatter plots suggest strong fluctuation (1-3°C) in daily water temperature and even stronger fluctuation (5-10°C) in bi-weekly water temperature. Harmonic regression analysis attributed 53% of temperature variance to interaction between 12.42 hour and 24 hour cycles, 27% of temperature variance to 24 hour cycles, and 20% of temperature variance to 12.42 hour cycles.

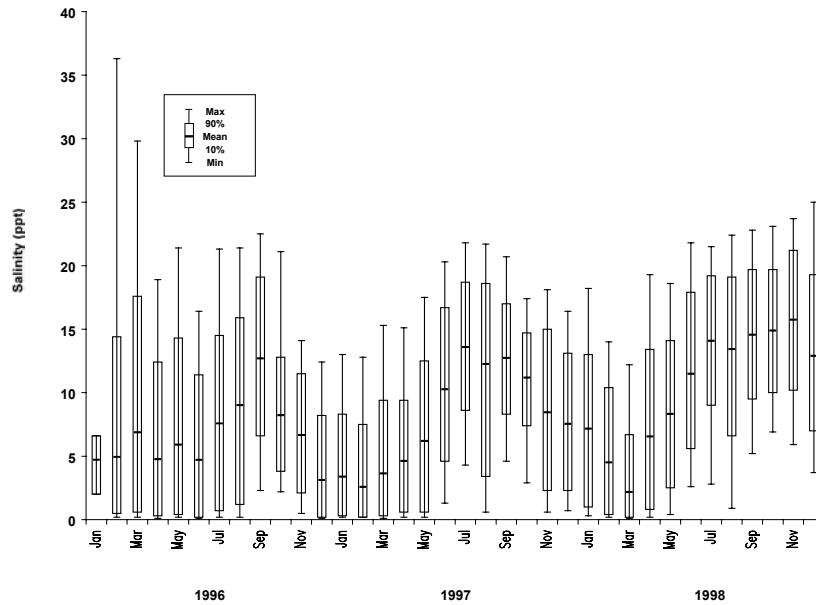


**Figure 108.** Water temperature statistics for Scotton Landing, 1996-1998.

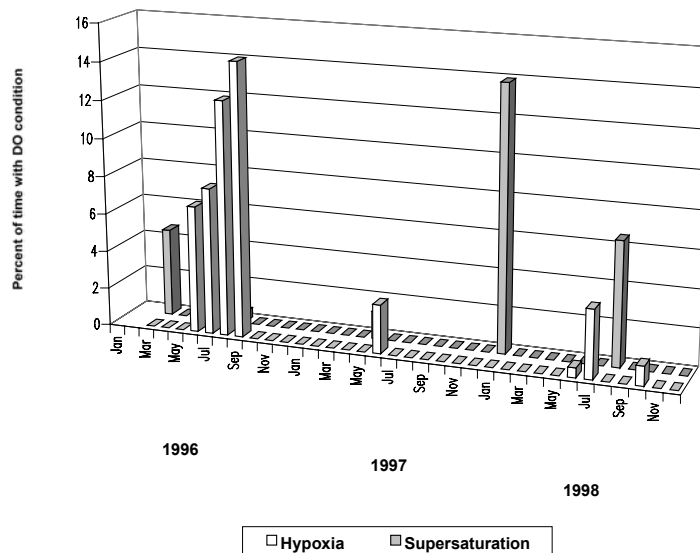
Eighty-four percent of annual salinity data were included in analyses (75% in 1996, 88% in 1997, 1998). Mean salinity followed a seasonal cycle; however, large variances about mean salinity were observed throughout the data (Figure 109). Mean salinity was 3-5 ppt in winter 1996-1998 and 13-16 ppt in summer/fall 1996-1998. Minimum salinity regularly approached 0 ppt and maximum salinity regularly approached 23 ppt. Scatter plots suggest strong fluctuations (5-15 ppt) in daily and bi-weekly salinity equivalent to or in excess of annual variation in salinity. Harmonic regression analysis attributed 55% of salinity variance to 12.42 hour cycles, 32% of salinity variance to interaction between 12.42 hour and 24 hour cycles, and 13% of salinity variance to 24 hour cycles.

Seventy-five percent of annual dissolved oxygen (% saturation) data were included in analyses (66% in 1996, 82% in 1997, and 78% in 1998). Mean DO followed a seasonal cycle; however, large variances were associated with mean values in summer. Mean dissolved oxygen in summer was 45-50% saturation and 75-100% saturation in fall/winter. Minimum and maximum dissolved oxygen recorded between 1996-1998 was 0% saturation (Jul 1996) and 346.9% saturation (May 1997), respectively. Hypoxia was observed in summer 1996-1998, but was most pronounced in summer 1996. When present, hypoxia typically lasted 6% of the first 48 hours post-deployment, but never persisted more than 15% of first 48 hours post-deployment (Figure 110). Supersaturation was

primarily observed between Mar-Aug 1996, with two additional noteworthy occurrences in Jan and Aug 1998. When present, supersaturation typically persisted less than 4% of the first 48 hours post-deployment and never exceeded 15% of the first 48 hours post-deployment. Scatter plots suggest moderate fluctuation (20-60%) in percent saturation throughout 1996-1998, but substantially stronger ( $\geq 100\%$ ) fluctuations in percent saturation in summer 1996 and 1998. Harmonic regression analysis attributed 55% of DO variance to interaction between 12.42 hour and 24 hour cycles, 32% of DO variance to 12.42 hour cycles, and 13% of DO variance to 24 hour cycles.



**Figure 109.** Salinity statistics for Scotton Landing, 1996-1998.



**Figure 110.** Dissolved oxygen extremes for Scotton Landing, 1996-1998.